MODEL 121A

SIERRA ELECTRONIC CORPORATION

WAVE ANALYZER

MODEL 121A

OFFICIAL RECORDS STATION
FILE COPY
FACILITIES

Serial Numbers 639-738

RETURN TO
SECTION 77
ISSUE NO. 1

Manufactured by

SIERRA ELECTRONIC CORPORATION

3885 Bohannon Drive
Menlo Park, California

WARRANTY

SIERRA ELECTRONIC CORPORATION warrants instruments manufactured by it and bearing Sierra commercial model numbers, except Ion Gauge Tubes, to be free from defective material and factory workmanship and agrees to repair such instruments, which under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any such instrument which in our sole opinion upon our examination proves to be so defective, when returned to our factory, transportation prepaid by the purchaser, within one year from the date of original purchase from us.

This warranty does not apply to any of our products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgement, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA ELECTRONIC CORPORATION assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

SIERRA ELECTRONIC CORPORATION reserves the right to make changes in the design or construction of any of its instruments at any time without incurring any obligation to make any changes whatever on units previously purchased.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to represent nor assume for us any liability in connection with the sale of our products other than that set forth herein.

SCI-195
July 18, 1956

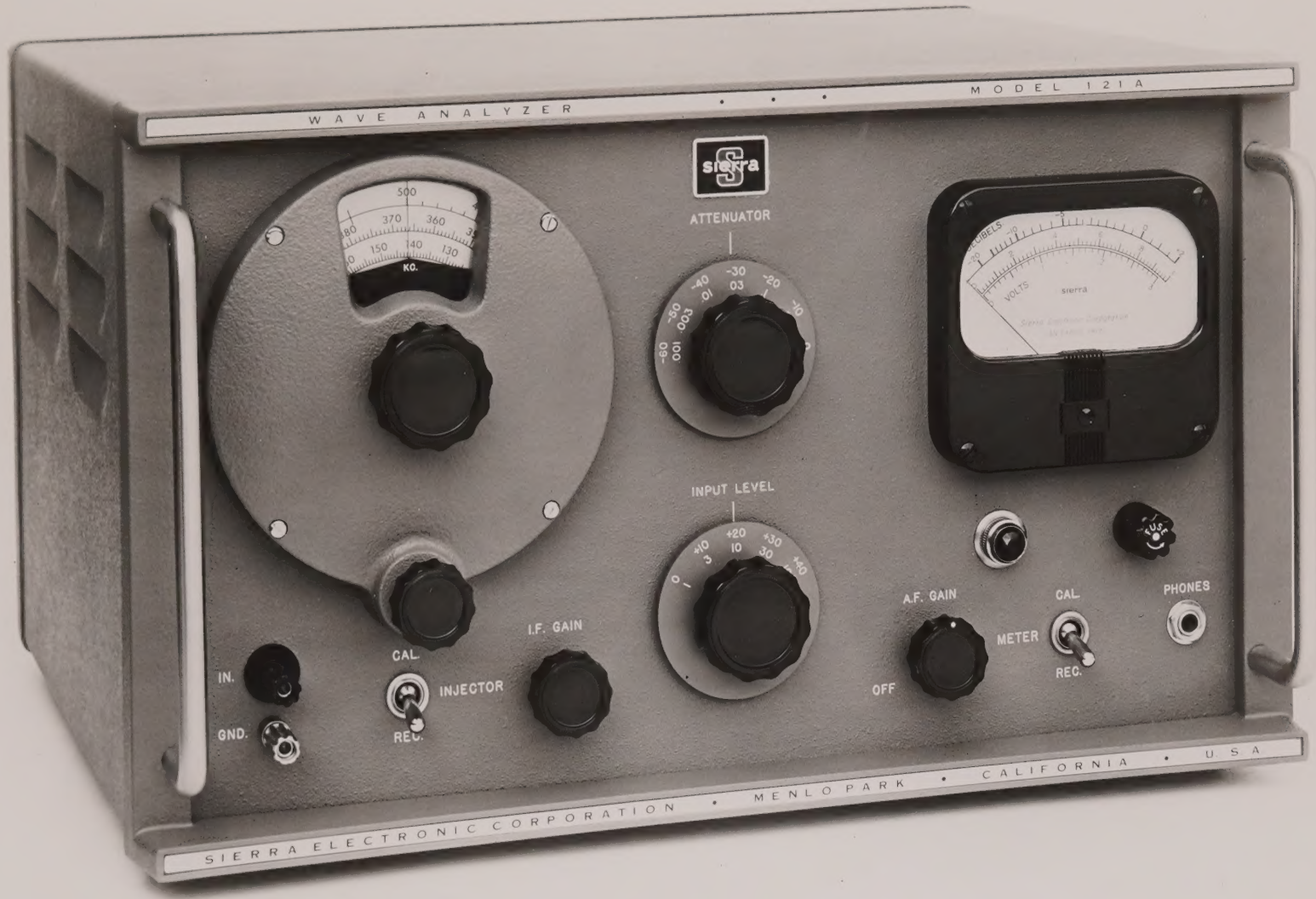
WAVE ANALYZER
MODEL 121A
sierra
ATTENUATOR
INPUT LEVEL
KC.
DECIBELS
VOLTS
sierra
FUSE
IN.
GND.
CAL.
INJECTOR
REC.
I.F. GAIN
A.F. GAIN
OFF
METER
CAL.
REC.
PHONES
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FIG. 1

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SUMMARY OF TECHNICAL SPECIFICATIONS

Frequency Range	15 kc to 500 kc
Input Level Range.....	-70 to +42 dbm (245 microvolts to 97.5 volts)
Measurement Accuracy.....	± 2 db for levels above -70 dbm ± 26%
Selectivity:	
1. 3 db down.....	±100 cps
2. 30 db down.....	± 500 cps
3. 45 db down	±1000 cps
Bridged Impedance for direct reading in dbm.....	600 ohms unbalanced
Input Impedance.....	10,000 ohms in pass band
Frequency Calibration Accuracy.....	±3 kc over range, 45°F to 90°F ambient
Spurious Responses.....	At least 50 db down
Power Input.....	105-125 volts, 50/60 cycles 85 watts
Fuse Protection.....	3 amperes
Overall Dimensions	
Width.....	17"
Height with stand retracted.....	10 1/8"
Height with stand extended.....	12 3/16"
Depth.....	14 1/4"
Weight.....	34 pounds.

SUMMARY OF TECHNICAL SPECIFICATIONS

OPERATING AND MAINTENANCE INSTRUCTIONS

for

MODEL 121A WAVE ANALYZER

1. GENERAL

The Model 121 Wave Analyzer is a selective detector for measuring voltages in the frequency range of 15 kc to 500 kc. It is designed for wave analysis with exceptionally low spurious frequency response. The input or bridging impedance is high (10,000 ohms in the pass band) and the instrument is direct reading in dbm, when bridged across 600-ohm unbalanced circuits. Two variable attenuators and an indicating meter provide a sensitivity range of -80 dbm to +42 dbm (77.5 microvolts to 97.5 volts at the input terminals). The attenuator and meter are also calibrated in voltage. For restrictions on use of voltage scale see paragraph on page 2 entitled DECIBELS Meter. A jack is provided on the front panel for monitoring the incoming signal with headphones.

The analyzer is equipped with an injection oscillator, which is in effect a signal generator, for the purpose of calibrating its sensitivity to input voltages.

2. DESCRIPTION

The front view of the wave analyzer is shown in the frontispiece, (Fig. 1). A block diagram, Fig. 2 is included to help the user understand the functions of the analyzer. The circuit schematic is shown on (Fig. 3).

a. Input Circuit

The signal input first passes through a section which includes an input filter and the INPUT LEVEL attenuator before arriving at the grid of the first mixer tube. The input filter has a pass band from 15 kc to 500 kc. Its purpose is to suppress all signals outside this band. The INPUT LEVEL attenuator merely reduces by known amounts the signal arriving at the grid of the first mixer tube so as to increase the voltage measuring range of the instrument and make possible the measurement of relatively large voltages. The most important function of this attenuator is to adjust the magnitude of the signal voltage impressed on the first mixer grid to a value which is well below that which would generate significant harmonic distortion components or would produce undesirable intermodulation effects. The INPUT LEVEL attenuator steps are in 10 db intervals between 0 dbm and +40 dbm.

b. Converter Circuits

The KC. tuning dial on the front of the analyzer indicates the signal

input frequency directly in kc and controls the frequency of a variable-frequency oscillator over a range of 1125 kc to 1610 kc. The output of this oscillator combines (heterodynes) with the incoming signal in the first mixer tube to produce an intermediate frequency (I.F.) of 1110 kc. After passing through the selective bandpass transformer the 1110-kc signal combines in the second mixer tube with a 1080-kc crystal-controlled oscillator frequency to produce a second intermediate frequency of 30 kc. After passing through a selective bandpass transformer the 30-kc signal is applied to the grid of a cathode follower stage, the cathode circuit of which contains another or main ATTENUATOR.

The main ATTENUATOR steps are in 10-db intervals between 0 dbm and -60 dbm. Unlike the INPUT LEVEL attenuator, the main ATTENUATOR operates at only one frequency, 30 kc, and is therefore capable of a higher order of accuracy. Signals from the main ATTENUATOR pass through a highly selective 30-kc intermediate-frequency amplifier circuit and go directly into the crystal detector, the dc output of which operates the DECIBELS meter. The I.F. GAIN control, which is provided for adjusting the overall gain of the analyzer, is contained in the cathode circuit of the first amplifier tube in the 30-kc I.F. amplifier section.

c. DECIBELS Meter

The output indicating meter has a 0-200 microampere range, but the scale is calibrated in both decibels and volts. The meter calibration in conjunction with the calibrations on the attenuator dial indicate the voltage levels at the probe input terminal. The instrument calibrations are based on one milliwatt dissipated in 600 ohms, recognized as 0 dbm. The voltage appearing across the resistor is 0.775 volts, rms. With the ATTENUATOR set at 0 db or 1, the DECIBELS METER will show 0 db or 0.775 volts when 0.775 volts is applied between the input probe terminal and ground.

CAUTION: When the Model 121A Wave Analyzer is received from the factory, the meter pointer may not rest on zero on the voltage scales. This condition is normal and the meter adjustment screw should not be readjusted. The zero adjust screw is set for optimum meter tracking accuracy and is sealed at the factory.

d. Listening Jack

A PHONES jack is provided on the front panel for the use of a headset, to listen to incoming signals. The headset is energized from an audio amplifier, the audio level of which is adjustable from the A.F. GAIN control on the front panel. In order to avoid the excessive depreciation of audio response that would be imposed by the highly-selective characteristics of the 30-kc intermediate-frequency amplifier, the audio amplifier with its associated crystal diode detector is connected ahead of the main ATTENUATOR.

e. Tuning Dial

The KC tuning dial on the front panel has two knobs. The larger knob, centrally located on the dial assembly, is for making coarse tuning adjust-

ments. The smaller knob, located the lower edge of the assembly, is a rim-drive control for making fine tuning adjustments.

f. Injection Oscillator

An injection oscillator, which operates at 100 kc, is included in the analyzer. This oscillator provides a fixed amplitude signal which can be switched to the input circuit and substituted for the incoming signal for calibration (gain standardization) purposes. When the INJECTOR switch is placed in the CAL position the input bandpass filter input connection is switched from the IN (input) terminal post of the analyzer to the injection oscillator output. At the same time the plate voltage is connected to the injection oscillator.

The injection oscillator circuit contains a vacuum tube voltmeter for monitoring the amplitude of oscillations to insure an accurate injection signal amplitude of "0" dbm at 100 kc (0.775 volts rms- the voltage developed when one milliwatt of power is delivered to 600 ohms). The dc output from the vacuum tube voltmeter circuit is shown on the DECIBELS meter when the METER switch is in the CAL (calibrate) position. This circuit is adjusted for an indication of 0 db when operating properly.

g. Regulated Voltage

The dc supply voltages used in the analyzer are regulated in the power supply section. The object of this arrangement is to insure relatively constant voltage in the instrument under conditions where the 115v supply is not constant. An adjustment is provided for setting the B supply voltage at its nominal 250 volt value.

h. Supply Voltage

This wave analyzer is designed to operate from a main supply of 115 volts, 50/60 cycles. It will operate satisfactorily in the range from 105 volts to 125 volts. The off-on power switch is incorporated in the A.F. GAIN control; turn clockwise for on position.

i. Power Consumption

The wave analyzer total power consumption is approximately 85 watts.

j. Fuse

A fuse for the main supply is located in a holder on the front panel and is accessible for replacement by unscrewing and withdrawing the black cap marked FUSE. Replacement fuses should be rated at 3 amperes and of the Littelfuse or Bussman 3AG type.

k. Dimensions

The overall dimensions of the analyzer are: 14-1/4" deep (over handles) by 17" wide by 10-1/8" high, with stand retracted. With stand down, height is 12-3/16".

l. Weight

The weight of the complete analyzer is approximately 34 pounds.

3. PERFORMANCE CHARACTERISTICS

a. Sensitivity

The wave analyzer is capable of measuring voltages equivalent to -70 dbm to +42 dbm (245 microvolts to 97.5 volts, rms, respectively, across 600 ohms) using the upper portion of the DECIBELS meter scale between -10 db and + 2 db.

b. Accuracy

Over the frequency range 15 to 500 kc, the overall accuracy at any attenuator setting and meter reading (between - 10 db and + 2 db on the meter scale) is within ± 2 db. Less accuracy is obtained when using the DECIBELS meter scale below the - 10 db mark.

c. Frequency Calibration

The KC. tuning dial, which is calibrated to indicate the 15 to 500 kc input signal frequency range directly in kc, depends for its accuracy upon the calibration accuracy and stability of the 1125 to 1610 kc variable oscillator. Since this oscillator is calibrated and maintained to within 0.2%, the resulting tuning dial accuracy will range from ±2 kc at the low frequency end of the dial to ± 3 kc at the high frequency end.

d. Selectivity

At frequencies 100 cps off resonance, the response is approximately 3 db down. At 200 cps off resonance, the response is at least 10 db down; at 500 cps, at least 30 db down; and at 1000 cps, at least 45 db down.

e. Spurious Responses

Spurious responses originating within the wave analyzer are kept to a very low magnitude when the instrument is operated in accordance with the operating instructions given therein. There are various types of spurious responses generally encountered in equipments of this type, and they have been classified

and defined in various Standards and textbooks related to the radio engineering art. For the convenience of the reader, applicable descriptions of some of these categories are given herewith:

Harmonic Distortion is generated when the signal amplitude applied to the grid of a vacuum tube is large enough to cause operation over more than the linear range of the grid-plate characteristic.

Direct I.F. Responses can take place when signals applied to the input terminals are at frequencies equal to the Intermediate Frequency Amplifier values used within the equipment, with the KC. tuning dial not adjusted to a setting which would tune these frequencies in.

Image Responses can take place when a signal applied to the input terminals is at a frequency that is twice the Intermediate Frequency above the KC. tuning dial setting.

Oscillator Beats can produce a spurious meter reading, in the absence of an applied input signal, when the difference between the variable oscillator frequency (or any of its harmonics) and the crystal oscillator frequency (or any of its harmonics) corresponds to the 30 kc 2nd I.F. of the wave analyzer. Although this phenomenon can occur at many different settings of the KC. tuning dial, only a very few are prominent enough to be detectable.

Representative values of the various type of spurious responses are as follows:

Harmonic Distortion

2nd harmonic:	-60 db to -70 db with respect to applied pure sine wave
3rd harmonic:	-55 db to -62 db with respect to applied pure sine wave
Higher harmonics:	over -70 db " " " " " " "

Direct I.F. Responses

1110 kc:	51 to 57 db rejection
30 kc:	more than 70 db rejection

Image Responses

2220 kc above tuning dial setting:	greater than 60 db rejection
60 kc " " " " :	53 to 58 db rejection

Oscillator Beats

At 495 kc tuning dial setting:	-60 dbm
At 340 kc " " "	-70 dbm
At 320 kc " " "	-70 dbm
At 192 kc " " "	-80 dbm
At 180 kc " " "	-80 dbm

f. Input Impedance

The input impedance of the wave analyzer in the pass frequency band 15 to 500 kc is equivalent to approximately 10,000 ohms resistance shunted by 25 mmf of capacitance. Outside the pass band the impedance rises in magnitude but becomes predominantly reactive in sign.

4. OPERATION

a. Calibration Using Injector Oscillator

The injection oscillator is adjusted at the factory to deliver a 100 kc signal level of 0.775 volts (equivalent to 0 dbm on 600 ohms) to the wave analyzer input circuit for calibrating purposes when the INJECTOR switch on the front panel is placed in the CAL position. The switch changes the internal circuit from the IN (input) terminal to the injection oscillator output (see block diagram) and at the same time connects the plate voltage to the oscillator.

In order to make certain the amplitude from the injector oscillator is correct, the d-c output from the diode vacuum tube voltmeter circuit in the injector oscillator may be switched to the DECIBELS meter by placing the METER switch in the CAL position. The circuit is adjusted at the factory to indicate "0" db on the meter when operating properly.

To use the injector for calibration:

1. Turn the wave analyzer on by rotating the A.F. GAIN control knob clockwise from its extreme counter-clockwise position. Allow the instrument to warm up for at least 20 minutes.

2. Place the INJECTOR switch in the CAL position.

3. Place METER switch in the CAL position. The DECIBELS meter should show "0" db.

4. Return the METER switch to the REC position, set the INPUT LEVEL and ATTENUATOR dials both at "0" dbm, and adjust the KC. tuning dial for maximum reading on the DECIBELS meter when tuned to the 100 kc injector oscillator signal. If the resultant meter reading is not "0" db it should then be set to this value by means of the I.F. GAIN control knob. The wave analyzer sensitivity is now adjusted to its standard gain value.

5. Return the INJECTOR switch to the REC position. The wave analyzer is now ready for making measurements.

b. General Measurement Methods

After going through the calibration procedure outlined above, the following measurement procedure should be employed.

1. Connect the wave analyzer across the signal circuit to be measured by means of a pair of leads to the IN (input) and GND (ground) binding posts.

2. With the main ATTENUATOR set at "0" tune the wave analyzer over its entire frequency range of 15 to 500 kc and find the input signal frequency component having the largest amplitude. This is usually the fundamental component if a single source of signal energy is acting upon the circuit; but it may be any one of a group of harmonically-unrelated signals if, for example, a multi-channel carrier system is involved. On this largest amplitude component, adjust the INPUT LEVEL attenuator so that the DECIBELS meter reading occurs somewh ere between -8 db and + 2 db on its scale. If no signal component is encountered which is large enough to give the desired reading, turn the main ATTENUATOR down by one 10 db step and repeat the procedure. Continue until successful. Note the combined reading of the INPUT LEVEL and ATTENUATOR dials and the DECIBELS meter for this signal component.

3. With the INPUT LEVEL attenuator unchanged from the position arrived at in the above operation, proceed now to tune in the various other signal components whose levels are desired, and, for each one, adjust the ATTENUATOR dial to that position necessary for a meter reading in the -10 to + 2 db region of the scale. Note the combined reading of the INPUT LEVEL dial, ATTENUATOR dial and the DECIBELS meter for each of these components.

4. The db differences between each of the various combined readings obtained in step 3 and the combined reading obtained in step 2 (for the largest amplitude compon. represent the ratios of the lower-amplitude components : the largest amplitude component.

As an illustrative example, assume the wave analyzer is being used to measure the harmonic content of a 96 kc signal generator feeding a 600 ohm circuit. The wave analyzer is first standardized for gain as indicated in section 4a. The 96 kc input signal is then tuned in, and, with the main ATTENUATOR dial

left at its "0" setting the INPUT LEVEL dial is adjusted to give a suitable reading on the DECIBELS meter. Suppose this meter reading is "-2" db, when the INPUT LEVEL dial is set at "+ 10". This indicates that the fundamental component of the signal generator output has a level of 0 + 10 - 2 = + 8 dbm. Without changing the + 10 setting of the INPUT LEVEL dial, rotate the frequency dial of the wave analyzer to tune in the second harmonic (192 kc) of the signal generator under test adjusting the setting of the ATTENUATOR dial to give a suitable DECIBELS meter reading. Suppose this meter reading is "-7" db, when the ATTENUATOR dial is set at -30. From this, the second harmonic output level of the signal generator is -30 + 10 - 7 = -27 dbm, which is -35 db with respect to the fundamental. Other harmonic components may be measured in the same manner.

c. Calibration Using External Source

If it is desired to use an external source for sensitivity calibration, the I.F. GAIN control on the front panel of the wave analyzer should be adjusted to produce "0" db reading on the indicating meter with both the INPUT LEVEL and ATTENUATOR dials set at "0", the KC. tuning dial tuned to the incoming signal and with a signal amplitude of 0.775 volts rms (the voltage developed by 1 milliwatt, i.e. 0 dbm, across 600 ohms) applied to the input terminals. With this adjustment the wave analyzer is set at its standard gain point, i.e., at normal sensitivity. For general sensitivity checks, the frequency used should be approximately 100 kc. However, for maximum accuracy this adjustment should be made in the region of the frequencies under measurement. Always make certain that the tuning dial is set for maximum response to the input frequency.

d. Tuning Dial

The KC. tuning dial on the front panels reads directly in kilocycles over the signal frequency range of 15 to 500 kc. The center knob is used to turn the dial when large changes of frequency are desired, whereas the small rim-drive knob below is used for "fine" tuning. The special spiral dial scale has an effective length of 33 inches and the pointed shutter sliding vertically in the dial window indicates which section of the scale is to be read.

Measurements below 15 kc should not be attempted because an error is introduced when the frequency of the 1125 to 1610 kc variable heterodyne oscillator approaches that of the 1110 kc I.F. circuit. This error is evident by the large DECIBELS meter deflection in the region of zero on the KC. tuning dial.

e. Injector Oscillator Harmonics

The injection voltage is selected from a portion of the Injector Oscillator circuit which is rich in harmonics in order to produce usable DECIBELS meter deflections when the KC. tuning dial is adjusted to the harmonics of 100 kc,

i.e., to the 200 kc, 300 kc, 400 kc, and 500 kc settings. This feature is provided for a quick check of the KC. tuning dial frequency calibration.

CAUTION — Use only the 100 kc tuning dial setting for gain calibration purposes when using the Injector Oscillator as a source of known amplitude signal, since the harmonic voltage amplitudes differ from the amplitude of the 100 kc fundamental.

f. Use of Head-Phones

A head-set may be used for listening to the incoming signals, by plugging into the PHONES jack below the DECIBELS meter. The audio level is adjustable by means of the control knob labeled A.F. GAIN. Because of the sharp selectivity of the wave analyzer, only low frequency modulation components of the incoming carriers will be heard, namely those components below about 1000 cps. The head-set should be of the high-impedance type, preferably above 10,000 ohms, because low impedance phones will not respond as well.

5. MAINTENANCE

a. General

For purposes of reference, schematic diagram E-3561-4 and parts list SA-3562-1 are attached. The Model 121 Wave Analyzer should require no maintenance during normal use except for occasional change of tubes and the removal of dust and dirt. The change of power supply regulator tube V9, V10, and V11 may require that the regulator potentiometer "V" be readjusted to obtain the correct B+ supply value of 250 volts. Adjustment "V" is located on the top of the chassis near the case of the DECIBELS meter. The change of mixer of I.F. amplifier tubes V1, V2, V3, V4, and V5 may possibly affect the sensitivity of the instrument. Therefore, a re-standarization of gain should be made, using either the injector oscillator or an external source of known amplitude voltage preferably around 100 kc. (See instruction in section 4c above). If standard sensitivity is found not to be attainable within the nominal ±7 db range of adjustment afforded by the I.F. GAIN control, the wave analyzer circuits should be realigned and/or re-adjusted as later described. Change of tubes V3 and V7 will require that the external tube shield and accompanying grounding clip (on pin #8) be transferred from the old tube to the replacement tube.

b. Injector Oscillator

If the injector oscillator tube V6 is changed, the following adjustment procedure should be followed, after allowing at least d 20 minute warm-up period:

1. With INJECTOR switch in CAL position and METER switch in CAL position, adjust potentiometer shaft

"W" (at top left rear of chassis) with screw-driver to give "0" db reading on indicating meter.

2. Return METER switch to REC position and adjust frequency of injector oscillator to 100 kc by using insulated screw-driver in inductor tuning screw at location marked "H" on rear wall of chassis. Tuning can be accomplished by direct beating of injector oscillator with external frequency standard; or by tuning injector oscillator frequency for maximum deflection of DECIBELS meter when KC. tuning dial is set to 100 kc. The latter 100 kc tuning dial point should, for maximum accuracy, be preset against an external frequency standard.

3. After frequency of injector oscillator has been set, the DECIBELS meter should read "0" db (providing first that the wave analyzer sensitivity level has been properly adjusted by means of the I.F. GAIN control in accordance with the External Calibration instructions given in section 4c above). If pointer on DECIBELS meter is not at "0" db, the correct injection level can be set by adjusting potentiometer shaft "P" (at top left rear of chassis next to shaft "W") with a screwdriver. Interaction between adjustment "H", "P" and "W" may require that the above procedure be repeated several times.

c. Variable Frequency Oscillator

In case it is necessary to change tube V7 (located on the under side of the chassis) in the variable oscillator circuit (to which tuning dial is connected) it may also be necessary to readjust some of the circuit constants so that the KC. tuning dial calibration accuracy is preserved. The adjustments are accomplished as follows:

1. Adjust the frequency of the injector oscillator to exactly 100 kc in accordance with Para. 5b 2 above. (The INJECTOR switch is in the CAL position for this condition).

2. Set the KC. tuning dial at 500 kc, the INPUT LEVEL dial at "0" and the ATTENUATOR dial at "-20" and adjust the variable oscillator trimmer capacitor "X" (with an insulated screwdriver) for maximum response (to injector 5th harmonic) on the indicating meter. The trimmer adjustment is located through the hole designated "X" on the left side of the variable oscillator housing.

3. Set the KC. tuning dial at 100 kc, and INPUT LEVEL and ATTENUATOR dials at db, and adjust the variable oscillator inductor screw "O" (adjacent the trimmer capacitor "X") for maximum response (to the 100 kc fundamental of the injector) on the DECIBELS meter.

4. Since there is a slight amount of interaction between the settings of "X" and "O", steps 5c 2 and 5c 3 should be repeated three or four times to arrive at the proper final settings for these adjustments.

5. As a final check tune in the 200 kc, 300 kc, and 400 kc, harmonics of the injector oscillator to verify that the frequency calibration of the tuning dial is within the specified accuracy limits over the entire range.

d. Alignment Procedure

In the event it is found necessary to electrically re-align the wave analyzer, as mentioned in 5a, the following procedure is recommended:

1. From a suitable low-impedance signal generator apply 2500 microvolts rms at 30 kc between grid No. 1 (pin 4) of vacuum tube V4 and the chassis and tune I.F. coils T4 and T5 for maximum response on the indicating meter. The locking nuts on the core screws of the above coils should be loosened slightly just prior to this tuning adjustment and then re-tightened after the adjustment is completed, being careful not to disturb the settings of the adjustment screws in the tightening process. The I.F. GAIN control should be set at the extreme counter-clockwise position (minimum gain) and the METER switch in REC position. The meter should read between +2 db and -4 db on the DECIBELS meter scale.

2. Apply .035 volts rms at 30 kc between grid #3 (Pin 7) of V2 and the chassis and adjust trimmer capacitors C20 and C18 for maximum response. Since this band pass circuit is operated at "critical" coupling to obtain a flat-topped response curve, these adjustments should

be made only by qualified personnel. The ATTENUATOR dial should be set at "0" db for this adjustment.

3. Without disconnecting the signal generator from the above circuit location, change its output frequency to 1110 kc (at .035 volts rms) to check the operation of V2 as a mixer stage. With the I.F. GAIN control at its extreme counter-clockwise position (minimum gain), the meter should read between +2 db and - 8 db.

4. Connect the signal generator between grid #3 (Pin 7) of V1 and chassis ground, and, with its output set to give .037 volts rms at 1110 kc tune the core screw adjustments of I.F. coils T2 and T3 to give maximum response on the indicating meter. (The ATTENUATOR and INPUT LEVEL dials should be set at 0 db for this adjustment). Then tune the signal generator to 1050 kc and adjust the core screw of L16 to give minimum response on the indicating meter, turning the ATTENUATOR dial down toward the -50 db position as the null adjustment is approached. Repeat the 1110 kc adjustments to remove interaction effects.

5. With the signal generator connected as in the above step, rotate the I.F. GAIN control over its range of adjustment (which is approximately 14 db) to determine whether a "0" db meter reading can be obtained within the range of I.F. GAIN control. The "0" db I.F. GAIN control setting should not be too near either end of its control range. If it is, adjustment of special coupling capacitor C9 may be made (by bending the plates slightly) to center the range of action of the I.F. GAIN control.

6. Connect the signal generator to the input binding posts of the wave analyzer, adjusting its output to give approximately 1 volt rms at 1110 kc. Adjust the inductor core screw marked "L" (located on chassis beneath gear train) to obtain a minimum reading on the indicating meter, using the ATTENUATOR dial down to the -40 or -50 db step if necessary. The INPUT LEVEL dial should not be changed from its 0 db setting.

e. Special Adjustments

Changing the mixer tubes V1 and V2 may require readjustment of special purpose circuit constants other than those covered in the alignment

instructions given in section 5d above. These include the neutralizing capacitors C4 and C11 and the cathode bias potentiometer marked "K". They are adjusted as follows:

1. With no signal applied to the wave analyzer input, and with the ATTENUATOR and the INPUT LEVEL dials at 0 db, the INJECTOR and METER switches on REC, and the KC. tuning dial set at the 250 kc point, hold a low capacitance r.f. vacuum tube voltmeter (Hewlett-Packard Model 410-A or B, 1 volt range) probe on grid #3 (pin 7) of V2 and adjust C11 for a minimum reading on the V.T.V.M.

2. Transfer the V.T.V.M. probe to grid #3 (Pin 7) of V1 and, in a similar manner to that followed above, adjust C4 for a minimum reading.

3. Remove V.T.V.M., feed a 100 kc pure sine-wave signal (i.e., harmonics at least 70 db below fundamental, by means of a good low-pass filter) into the wave analyzer input terminals at a voltage level equivalent to 0 dbm on 600 ohms (0.775 volts rms), tune wave analyzer to 200 kc and adjust potentiometer "K" for a "minimum dip" in the 200 kc response as read on the DECIBELS meter. This adjustment yields the cathode bias value giving minimum distortion in the dynamic signal characteristic of V1. It will be necessary to turn the ATTENUATOR dial down to its -50 or -60 db position for the final stage of this adjustment if optimum results are desired.

   If a pure sine-wave signal of the type specified above is not available, a compromise adjustment of potentiometer "K" can be made by feeding a 100 kc signal (of no more than 1% distortion) into the wave analyzer, tuning the dial to 100 kc and adjusting "K" to obtain its "maximum gain" position. This "maximum" will tend to be rather broad, so that the optimum adjustment point is somewhat obscure when using this compromise method. Nevertheless, reasonably good performance of the wave analyzer can be realized.

6. PARTS LIST

Page 15 to Page 19 contains the Electrical Parts List of components for this wave analyzer.

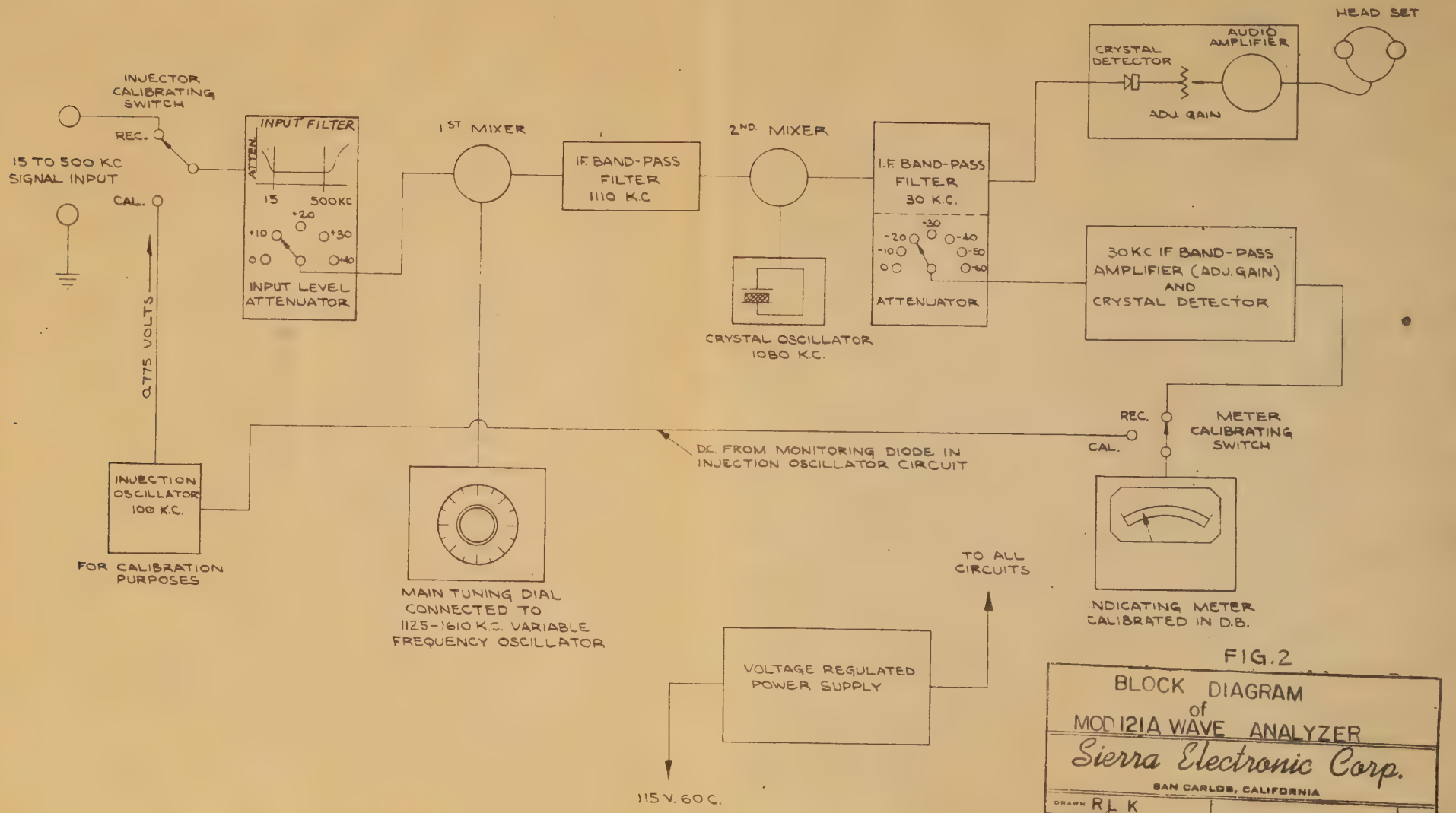


FIG. 2

BLOCK DIAGRAM
of
MOD 121A WAVE ANALYZER

Sierra Electronic Corp.
SAN CARLOS, CALIFORNIA

DRAWN R L K		ISSUE
C'K'D.	APP'D.	E-3717-2
DATE 3-16-53		
SCALE	SHEET NO. OF SHEETS	

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr.	Designation
C1	Silver mica .003 mf ±2% 500Vdcw	20G302	El-Menco	CM30E302
C2	Silver mica .003 mf ±2% 500Vdcw	20G302	El-Menco	CM30E302
C3	Silver mica 50 mmf ±2% 500Vdcw	20G500	El-Menco	CM15E500
C4	Ceramic 1.5-7 mmf ±2% 350Vdcw	32B070	Erie	557-NP0
C5	Ceramic .02 mf GMV 500Vdcw disc	14X203	Centralab	DD-203
C6	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C7	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C8	Not Used			
C9	Adjustable air 0.1-1.0 mmf	None	Sierra	SU-3708-1
C10	Not Used			
C11	Ceramic 1.5-7 mmf ±2% 350Vdcw	32B070	Erie	557-NP0
C12	Silver mica .0016 mf ±3% 500Vdcw	20H162	El-Menco	CM20D162H
C13	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C14	Silver Mica 100 mmf ±5% 500Vdcw	20J101	El-Menco	CM15E101
C15	Paper Tubular 0.25 mf +20% -10% 400Vdcw	10B254	Sangamo	3304025
C16	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C17	Silver mica .003 mf ±2% 500Vdcw	20G302	El-Menco	CM-30E302
C18	Mica 265-880 mmf 500Vdcw	34X881	El-Menco	306-M
C19	Ceramic 4.5-25 mmf 500Vdcw	32X250	Erie	TS2A-NP0
C20	Mica 265-880 mmf 500Vdcw	34X881	El-Menco	306-M
C21	Silver mica .003 mf ±2% 500Vdcw	20G302	El-Menco	CM30E302
C22	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C23	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C24	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C25	Ceramic .001 mf GMV 500Vdcw disc	14X102	Erie	801
C26	Ceramic .02-.02 mf GMV 500Vdcw disc	14A203	Sprague	5HK-252
C27	Electrolytic 25 mf 25Vdcw tubular	22X256	Sprague	TVA-1205
C28	Ceramic .02 mf GMV 500Vdcw disc	14X203	Centralab	DD-203
C29	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C30	Ceramic .001 mf GMV 500Vdcw disc	14X102	Erie	801
C31	Ceramic 0.1 mf GMV 500Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C32	Ceramic 0.1 mf GMV 500Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C33	Ceramic 0.1 mf GMV 500Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C34	Not Used			
C35	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C36	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C37	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C38	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C39	Paper tubular .25 mf +20% -10% 400Vdcw	10B254	Sangamo	3304025

Electrical Parts List for
WAVE ANALYZER, MODEL 121 A

Schematic Diagram No. E-3561-2

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr.	Designation
C40	Not Used			
C41	Ceramic .02 mf GMV 500Vdcw disc	14X203	Centralab	DD-203
C42	Ceramic .02 - .02 mf GMV 500Vdcw disc	14A203	Sprague	5HK-2S2
C43	Silver mica 50 mmf ±2% 500Vdcw	20G500	El-Menco	CM15E500
C44	Ceramic .02 -.02 mf GMV 500Vdcw disc	14A203	Sprague	5HK-2S2
C45	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C46	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C47	Ceramic .001 mf GMV 500Vdcw disc	14X102	Erie	801
C48	Ceramic .001 mf GMV 500Vdcw disc	14X102	Erie	801
C49	Ceramic .02 -.02 mf GMV 500Vdcw disc	14A203	Sprague	5HK-2S2
C50	Ceramic 47 mmf ±5% 500Vdcw	14X470	Erie	N750K47±2.35
C51	Variable air 53 mmf nominal	28X530	Sierra	
C52	Ceramic 3-12 mmf 500Vdcw	32X120	Erie	TS2A-NEO
C53	Paper 0.1 mf 250Vacw Hy-Pass	10A104	Sprague	48P9
C54	Electrolytic 20-20-20 mf 450Vdcw can.	22X206	Sangamo	BLT-4520
C55	Ceramic .01 mf GMV 500Vdcw disc	14X103	Erie	811
C56	Ceramic 0.1 mf GMV 600Vdcw flat Hi-Kap	14X104	Centralab	DF-104
C57	Paper 0.1 mf GMV 250Vdcw Hy-Pass	10A104	Sprague	48P9
C58	Silver mica 27 mmf ±5% 500Vdcw	20J270	El-Menco	CM15E270
C59	Silver mica 27 mmf ±5% 500Vdcw	20J270	El-Menco	CM15E270
C60	Silver mica 27 mmf ±5% 500Vdcw	20J270	El-Menco	CM15E270
C61	Ceramic 15 mmf ±5%	14X150	Erie	N750A15, ± .75 mmf.
BP1	Binding Post Assembly (Pair)	152X1	Millen	37222
		152X2	Millen	37202
CR1	Germanium diode 1N34A	105X1N34A	Sylvania	1N34A
CR2	Germanium diode 1N54A	105X1N54A	Sylvania	1N54A
F1	Fuse 3 amp. type 3AG	132X2	Littelfuse	312003
I1	Indicator lamp 6-8 volt 0.15 amp T3-1/4 bulb	138X1	Nat. Union	N47
J1	Jack Phone - plain	144X3	Switchcraft	11-JAX
L1	Fixed 2.5 MH ±3% 19.5 ohms dc	90X4	Sierra	
L2	Fixed 2.5 MH ±3% 19.5 ohms dc	90X4	Sierra	
L3	Fixed 100 MH ±3% 210 ohms dc	90X5	Sierra	
L4	Not Used			
L5	Not Used			
L6	Fixed 2.5 MH ±3% 19.5 ohms dc	90X4	Sierra	
L7	Fixed 8.0 MH ±1% Q180 @30 kc	90X2	Lenkurt	Type TLFX
L8	Fixed 8.0 MH ±1% Q180 @30 kc	90X2	Lenkurt	Type TLFX
L9	Fixed 150 MH ±3% 268 ohms dc	90X6	Sierra	
L10	Not Used			
L11	Not Used			

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr.	Designation
L12	Variable 20-50 MH Q80 @50 kc	94X4	Sierra	
L13	Variable 203 uh nom. Q110 @1200 kc	94X5	Sierra	
L14	Filter reactor 360 ohms dc max. 50 ma	92X2	Sierra	
L15	Variable 760 uh nom. Q120 @1110 kc	94X7	Sierra	
L16	Variable 760 uh nom. Q120 @1110 kc	94X7	Sierra	
M1	Meter 200 microamp. 400 ohms res. with special scale	118X4	Sierra	
P1	Plug & line cord assembly, #18/3 Type SJ 10'6" overall length molded parallel blade rubber cap, with radial grounding pin	164X2	Cornish Wire	3533
R1	5,000 ohm ±1% 1/2 watt	74X26	Electra	DC-1/2C
R2	4,500 ohm ±1% 1/2 watt	74X25	Electra	DC-1/2C
R3	341.9 ohm ±1% 1/2 watt	74X21	Electra	DC-1/2C
R4	108.1 ohm ±1% 1/2 watt	74X19	Electra	DC-1/2C
R5	34.19 ohm ±1% 1/2 watt	74X4	Electra	DC-1/2C
R6	10.81 ohm ±1% 1/2 watt	74X3	Electra	DC-1/2C
R7	5.00 ohm ±1% 1/2 watt	74X15	Electra	DC-1/2C
R8	39 ohm ±10% 1/2 watt	52X390	A.B.	Type EB
R9	250 ohm ±10% 2 watt carbon pot linear taper	79X32	Sierra	
R10	22,000 ohm ±10% 1/2 watt	52X223	A.B.	Type EB
R11	12,000 ohm ±10% 2 watt	60X123	A.B.	Type HB
R12	5,600 ohm ±10% 1/2 watt	52X562	A.B.	Type EB
R13	82 ohm ±10% 1/2 watt	52X820	A.B.	Type EB
R14	22,000 ohm ±10% 1/2 watt	52X223	A.B.	Type EB
R15	12,000 ohm ±10%, 2 watt	60X123	A.B.	Type HB
R16	3,300 ohm ±10% 1/2 watt	52X332	A.B.	Type EB
R17	1,000 ohm ±10% 2 watt	60X102	A.B.	Type HB
R18	1,000,000 ohm ±10% 1/2 watt	52X105	A.B.	Type EB
R19	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R20	1,200 ohm ±1% 1/2 watt	74X23	Electra	DC-1/2C
R21	5,638 ohm ±1% 1/2 watt	74X27	Electra	DC-1/2C
R22	2,162 ohm ±1% 1/2 watt	74X24	Electra	DC-1/2C
R23	683.8 ohm ±1% 1/2 watt	74X22	Electra	DC-1/2C
R24	216.2 ohm ±1% 1/2 watt	74X20	Electra	DC-1/2C
R25	68.38 ohm ±1% 1/2 watt	74X18	Electra	DC-1/2C
R26	21.62 ohm ±1% 1/2 watt	74X17	Electra	DC-1/2C
R27	10.0 ohm ±1% 1/2 watt	74X16	Electra	DC-1/2C

Electrical Parts List for Schematic Diagram No. E-3561-2

WAVE ANALYZER, MODEL 121 A

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr.	Designation
R28	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R29	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R30	250,000 ohm ± 10% 2 watt carbon pot linear taper	79X33	Sierra	
R31	1,000,000 ohm ±10% 1/2 watt	52X105	A.B.	Type EB
R32	47,000 ohm ±10% 1/2 watt	52X473	A.B.	Type EB
R33	1,000,000 ohm ±10% 1/2 watt	52X105	A.B.	Type EB
R34	560 ohm ±10% 1/2 watt	52X561	A.B.	Type EB
R35	5,000 ohm ±10% 2 watt carbon pot. linear taper	79X10	Sierra	
R36	100,000 ohm ±10% 1/2 watt	52X104	A.B.	Type E.B.
R37	10,000 ohm ±10% 1/2 watt	52X103	A.B.	Type EB
R38	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R39	2,200,000 ohm ±10% 1/2 watt	52X225	A.B.	Type EB
R40	270 ohm ± 10% 1/2 watt	52X471	A.B.	Type EB
R41	120,000 ohm ±10% 1/2 watt	52X124	A.B.	Type EB
R42	10,000 ohm ±10% 1/2 watt	52X103	A.B.	Type EB
R43	47,000 ohm ±5% 1/2 watt	50X473	A.B.	Type EB
R44	1,500 ohm ±10% 1/2 Watt	52X152	A.B.	Type EB
R45	250,000 ohm ±10% 2 watt carbon pot. linear taper	79X9	Sierra	
R46	2,500 ohm ±10% 2 watt carbon pot. linear taper	79X12	Sierra	
R47	100,000 ohm ±10% 1/2 watt	52X104	A.B.	Type EB
R48	1,500 ohm ±10% 1/2 watt	52X152	A.B.	Type EB
R49	100,000 ohm ±10% 1/2 watt	52X104	A.B.	Type EB
R50	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R51	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R52	1,000,000 ohm ±10% 1/2 watt	52X105	A.B.	Type EB
R53	1,000 ohm ±10% 1/2 watt	52X102	A.B.	Type EB
R54	120,000 ohm ±10% 1/2 watt	52X124	A.B.	Type EB
R55	56,000 ohm ± 10% 1/2 watt	52X563	A.B.	Type EB
R56	25,000 ohms ±10% 10 watt wire wound	64X253	Model Eng.	FRL-10
R57	2,200 ohm ±10% 1/2 watt	52X222	A.B.	Type EB
R58	1,000,000 ohm ±10% 1/2 watt	52X105	A.B.	Type EB
R59	39 ohm ±10% 1/2 watt	52X390	A.B.	Type EB
R60	47,000 ohm ±10% 1/2 watt	52X473	A.B.	Type EB
R61	25,000 ohm ±10% 2 watt carbon pot. linear taper	79X34	Sierra	
R62	39,000 ohm ±10% 1/2 watt	52X393	A.B.	Type EB
R63	180,000 ohm ±10% 1/2 watt	52X184	A.B.	Type EB

Electrical Parts List for Schematic Diagram No. E-3561-B

WAVE ANALYZER, MODEL 121A

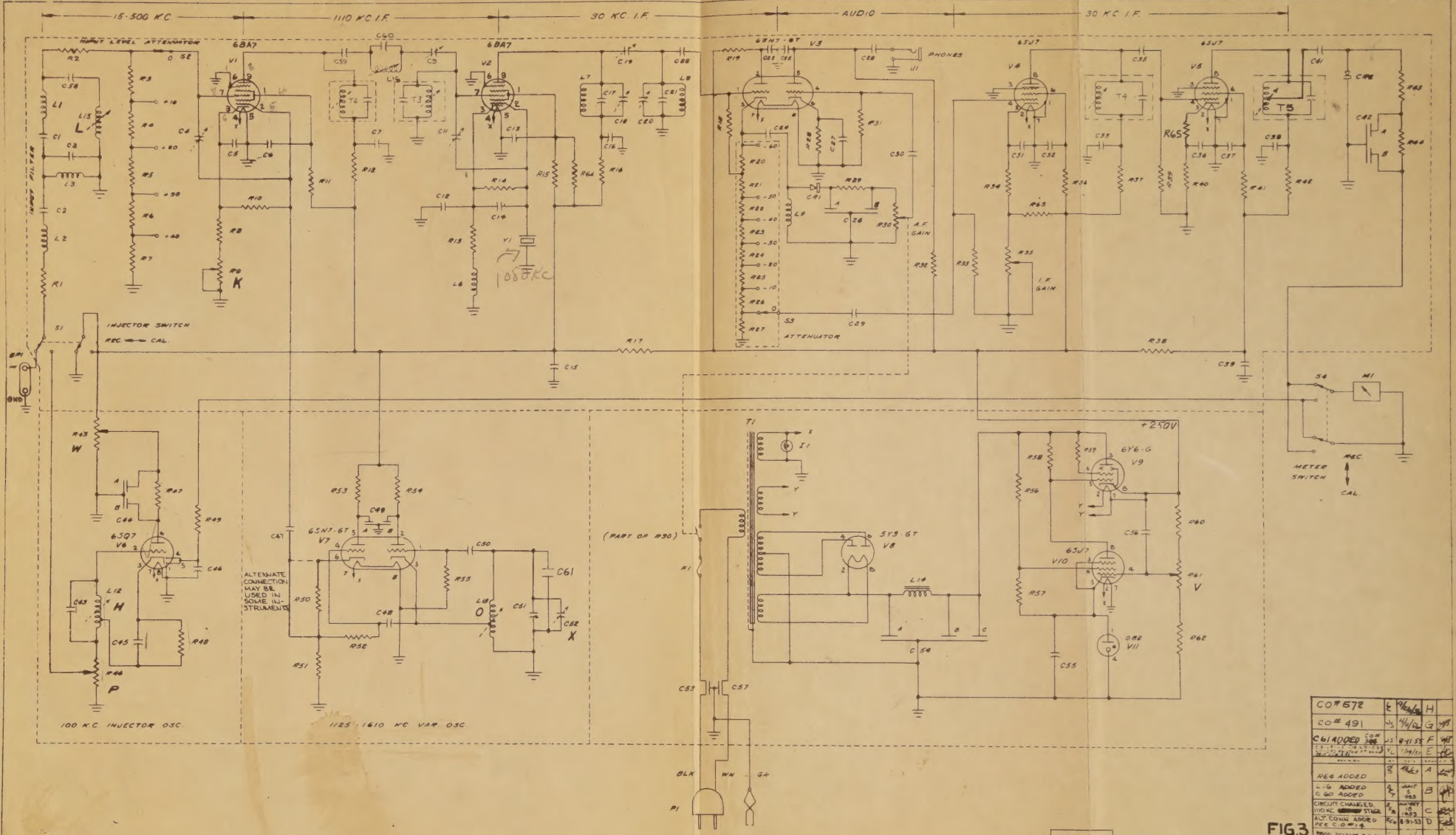
Schem. Ref. No.	Description	Sierra Stock No.	Mfgr.	Designation
R64	47,000 ohm ±10% 1/2 watt	52X473	A.B.	Type EB
R65	220 ohm ± 5 % 1/2 watt	50 X221	A.B.	Type EB
S1	Switch, toggle 3A, 125V bat handle	110X1	A-H & H	20905
S2	Switch, rotary 1 section 1 pole 5 position	112X5	Sierra	
S3	Switch, rotary 1 section 1 pole 7 position	112X6	Sierra	
S4	Switch, toggle 3A, 125V bat handle	110X1	A-H & H	20905
T1	Transformer, plate and filament prim. 115V - 50/60 cps	100X3	Sierra	
T2	Transformer, 1110 kc I.F.	94X13	Sierra	
T3	Transformer, 1110 kc I.F.	94X13	Sierra	
T4	Transformer, 30 kc I.F.	94X14	Sierra	
T5	Transformer, 30 kc I.F.	94X24	Sierra	
V1	6BA7 Vacuum Tube pentagrid mixer	107X6BA7		
V2	6BA7 Vacuum Tube pentagrid mixer	107X6BA7		
V3	6SN7-GT Vacuum Tube twin triode	107X6SN7GT		
V4	6SJ7 Vacuum Tube pentode	107X6SJ7		
V5	6SJ7 Vacuum Tube pentode	107X6SJ7		
V6	6SQ7 Vacuum Tube triode - duo diode	107X6SQ7		
V7	6SN7-GT Vacuum tube twin triode	107X6SN7GT		
V8	5Y3-GT Vacuum tube full-wave rectifier	107X5Y3GT		
V9	6Y6-G Vacuum tube tetrode	107X6Y6G		
V10	6SJ7 Vacuum tube pentode	107X6SJ7		
V11	OB2 gas tube voltage regulator	107XOB2		
Y1	Crystal quartz 1080 kc ±.02%	122X2	Sierra	
XF1	Fuse extractor post 3AG type	134X1	Littelfuse	342003
X11	Socket lamp 1/2" removable faceted jewel	142X1	Johnson	147-403
XY1	Socket crystal .750" pin spacing	142X2	Millen	33002
XV1	Socket Tube, 9-pin miniature	140X14	Cinch	13373
XV2	Socket Tube, 9-pin miniature	140X14	Cinch	13373
XV3	Socket Tube, octal black bckelite base	140X1	Cinch	9905
XV4	Socket Tube, octal black bckelite base	140X1	Cinch	9905
XV5	Socket Tube, octal black bckelite base	140X1	Cinch	9905

Electrical Parts List for WAVE ANALYZER, MODEL 121A

Schematic Diagram No. E-3561-2

Schem. Ref. No.	Description	Sierra Stock No.	Mfgr.	Designation
XV6	Socket Tube, octal black bakelite base	140X1	Cinch	9905
XV7	Socket Tube, octal black bakelite base	140X1	Cinch	9905
XV8	Socket Tube, octal black bakelite base	140X1	Cinch	9905
XV9	Socket Tube, octal black bakelite base	140X1	Cinch	9905
XV10	Socket Tube, octal black bakelite base	140X1	Cinch	9905
XV11	Socket Tube, 7-pin miniature	140X2	Cinch	13243

572



CO#572	LE	9/24/53	H	
CO# 491	LJ	4/4/53	G	
C61 ADDED CO# 386	LJ	8-11-53	F	
	VL	1/4/53	E	
			A	
R64 ADDED		9/24/53		
L16 ADDED C60 ADDED		MAY 5 1953	B	
CIRCUIT CHANGED, LUGS & STUDS		AUGUST 15 1953	C	
ALT. CONN. ADDED PER C.O. #18		8-31-53	D	
PROD. RELEASE 308				

LAST REF. AND COND. USED ON THIS DWG
C61 R66

FIG. 3

SCHEMATIC DIAGRAM
MODEL 121A WAVE ANALYZER
Sierra Electronic Corp.
SAN CARLOS, CALIFORNIA

DRAWN M. McCRAIGH	E-3561-2	H
DATE 6-17-53		